EXPERIMENTAL COMPUTATION OF FEIGENBAUM NUMBER

Kurk R. Craps (kaschon@iltsu.edu)
George H. Rutherford* (ghr@phy.ilstu.edu)
Epaminondas Rosa, Jr.* (erosa@phy.ilstu.edu)

Department of Physics, Illinois State University
Normal, IL 61790-4560

In 1978, while working at Los Alamos National Laboratory, Mitchell J. Feigenbaum discovered a new universal constant that applies to systems undergoing period doubling bifurcation. Feigenbaum found that, for parameter values of consecutive points of period doubling, there exists a convergence for the ratio of the distances between consecutive transitions. Assuming P_n as the parameter value of the *nth* bifurcation, the ratio δ_n can be computed as

$$\delta_n = \frac{P_{n+1} - P_n}{P_{n+2} - P_{n+1}}$$

In the limit, for large n, $\delta_n = 4.669\ldots$.
Here we present experimental results of external parameter measurements and use them to compute δ_n. The experimental setup consists of an electronic circuit with a nonlinear component responsible for the chaotic behavior of the system. By adjusting the potentiometers in the circuit we can manipulate the signal that is produced and with an oscilloscope we can note the points of period doubling. The resistance values of the potentiometer at the bifurcation points are taken and used as parameter values in the equation above. Experimental difficulties associated with the accuracy of the measurements will be discussed.